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The continuing challenge of nitrate and pesticide in groundwater

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Past, present and future: sources, transport and fate of pesticides in surface water and groundwater

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Groundwater and surface water resources are under increasing pressure from multiple stressors. These include chemical stressors, physical stressors, i.e. changes in land use leading to alterations in stream hydromorphology, and hydraulic pressures such as groundwater abstraction. Pesticides are among the most harmful class of compounds impacting groundwater and surface water, particularly since they have been so widely used to control the occurrence of pests and weeds in urban and agricultural landscapes. However, there is still a great deal of debate about the fate of pesticides and their future occurrence in our environment. We do not really understand the link between past usage and current observations, and are not well equipped to predict future trends in pesticide concentrations in groundwater.

At DTU Environment at the Technical University of Denmark we have in collaboration with national and international research partners had a long term focus on pesticides in order to:

1) Identify the main sources for pesticides in surface water and groundwater e.g. distinction between diffuse sources from agricultural use and from point sources such as old landfills.
2) Assess the transport and fate of pesticides in contaminated groundwater from point sources by use of laboratory, field scale experiments and numerical models. The recent focus has been on transport and fate of phenoxy acid herbicides into surface water from landfill sites.
3) Study the fate of pesticides in low concentrations in pristine aquifers by laboratory experiments. Recent results showed that bentazone might be degradable under aerobic conditions, which is important new information for assessment of the long term fate of bentazone in aquifers.
4) Explain trends in groundwater pesticide data and to speculate on the future fate of pesticides in the water environment by use of models. The results show that the occurrence of pesticides in drinking water supplies depends not only on the application history of the pesticide in the water catchment, but also on the pumping strategy used at water supply wells.
5) Assess current trends for pesticide concentrations in streams, their pathways into streams and their impact on stream ecosystems. Field investigations have been carried out at catchments in Denmar in order study the importance of groundwater as a pathway for pesticide impacts to ecosystems. Results show that pesticides were essential contributers to the overall ecological impairment of the studied streams. Chemical toxicity analyses identified particulate-bound insecticides as the primary source for ecotoxicity in the studied streams.

The presentation will show examples of the research with particular focus on historical pesticides such as phenoxy acid herbicides, and bentazone as an example of a newer pesticide still beeing used in Denmark.